

## 2001 Chevrolet S10 Pickup

2000-01 STEERING Power Recirculating Ball - Trucks - Except Tracker

### 2000-01 STEERING

#### Power Recirculating Ball - Trucks - Except Tracker

## MODEL IDENTIFICATION

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Series <sup>(1)</sup>	Model
"C"	2WD Pickup, Sierra, Silverado, Suburban, Tahoe & Yukon
"G"	Express & Savana
"K"	AWD Escalade, & 4WD Pickup, Sierra, Silverado, Suburban, Tahoe & Yukon
"L"	AWD Astro & Safari
"M"	2WD Astro & Safari
"S"	2WD Blazer, Jimmy, Pickup & Sonoma
"T"	AWD Bravada & Envoy, & 4WD Blazer, Jimmy, Pickup & Sonoma
(1) Vehicle series is fifth character of VIN.	

## DESCRIPTION & OPERATION

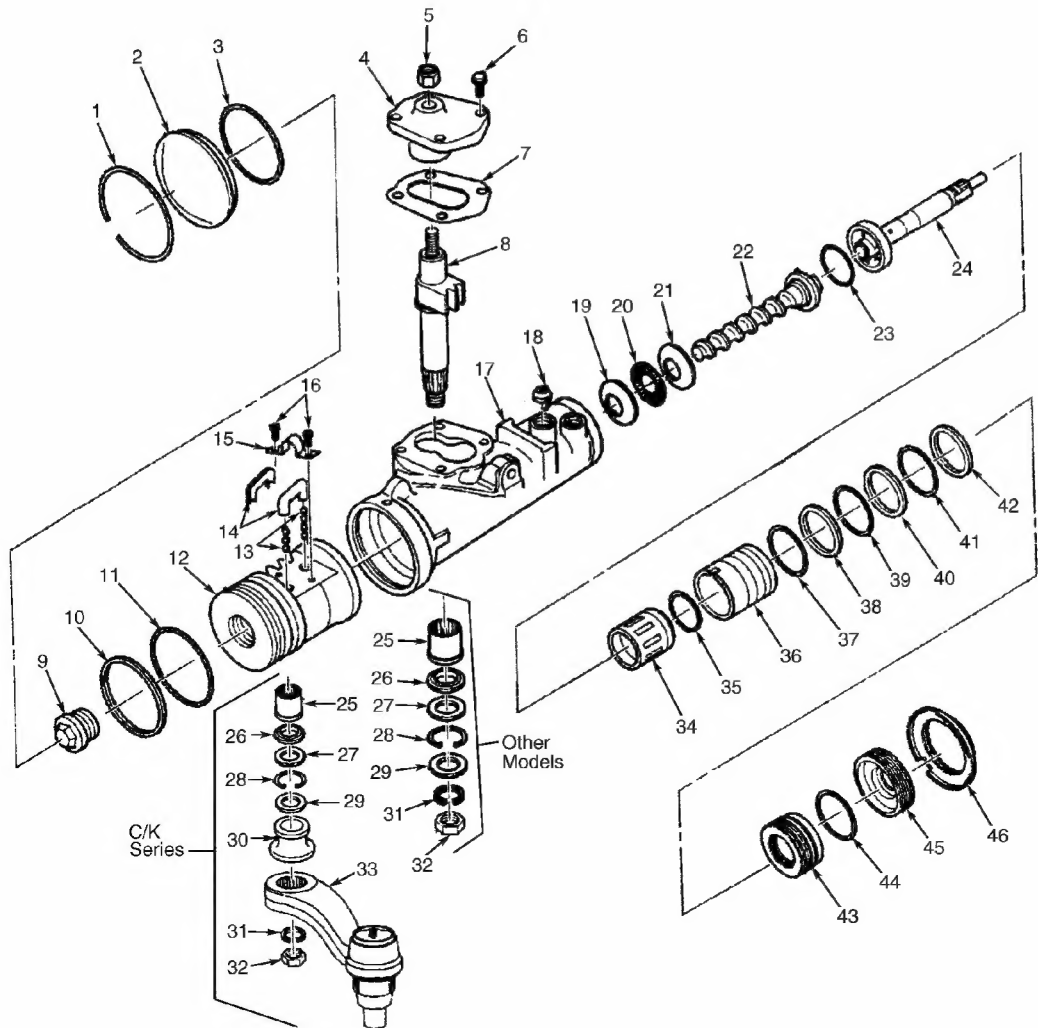
Steering gear is a variable ratio, recirculating ball-type which acts as a rolling thread between worm shaft and rack piston. The worm shaft is supported at lower end by a thrust bearing with 2 races. It is supported at upper end by a bearing assembly in the adjuster plug. Control valves, located inside steering gear housing, direct power steering fluid to either side of rack piston. See **Fig. 1** .

Steering linkage connects steering gear to front wheels through pitman arm. Steering linkage consists of pitman arm, idler arm, relay rod and tie rods. See **Fig. 3 -Fig. 9** . Tie rod ends connect to relay rod by ball studs. Adjuster tubes between inner and outer tie rod ends are used to adjust toe. Some models have a shock absorber attached to relay rod.

Two different types of vane-type power steering pumps are used. The "P" Type pump is mounted inside reservoir. See **Fig. 14** . The "CB" Type pump is mounted below reservoir. See **Fig. 16** . On both models, vanes are driven by a rotor and move fluid from intake to pressure cavities of pump ring.

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1. Retaining Ring
2. Housing End Plug
3. Seal
4. Side Cover
5. Pitman Shaft Lock Nut
6. Side Cover Bolt
7. Gasket
8. Pitman Shaft
9. Rack Piston End Plug
10. Ring
11. Seal
12. Rack Piston
13. Recirculating Balls
14. Ball Guides
15. Clamp
16. Screws

17. Steering Gear Housing
18. Check Valve
19. Worm Bearing Race
20. Worm Bearing
21. Worm Bearing Race
22. Worm Shaft
23. Seal
24. Stub Shaft
25. Pitman Shaft Bearing
26. Double Lip Seal
27. Washer
28. Retaining Ring
29. Dust Seal
30. Pitman Shaft Boot
31. Lock Washer

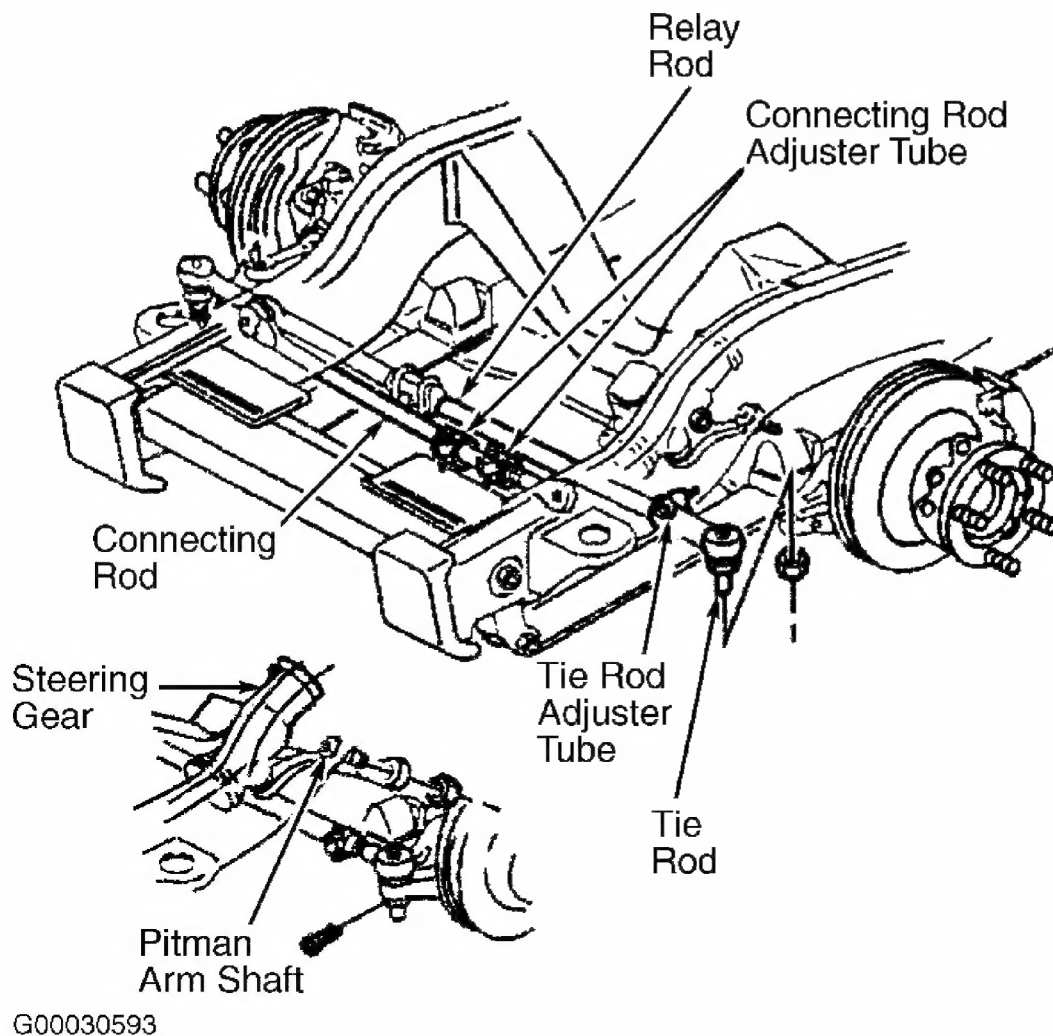
32. Nut
33. Pitman Shaft Arm
34. Valve Spool
35. Seal
36. Valve Body
37. Seal
38. Ring
39. Seal
40. Ring
41. Seal
42. Ring
43. Thrust Support Assembly
44. Seal
45. Adjuster Plug Assembly
46. Coupling Shield Retainer & Lock Nut

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**Fig. 1: Exploded View Of Power Steering Gear**  
**Courtesy of GENERAL MOTORS CORP.**

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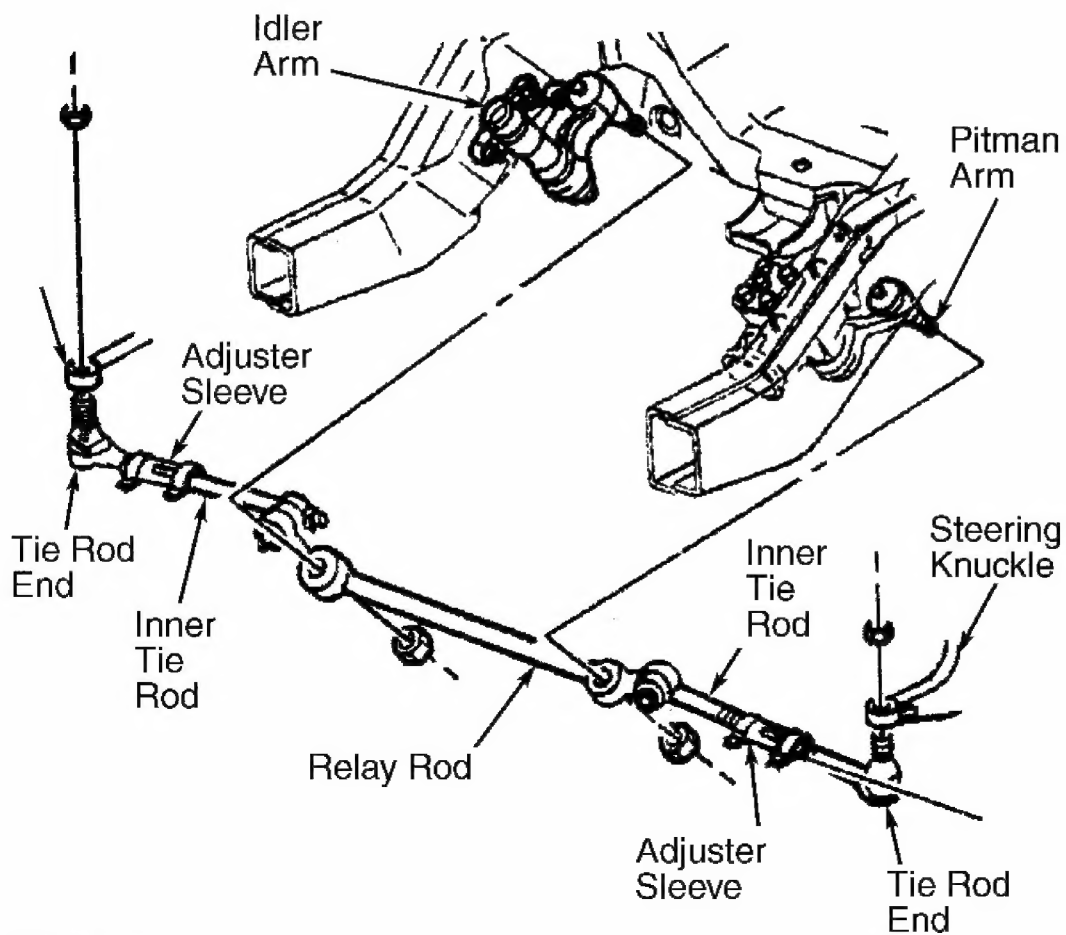
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**Fig. 2: Exploded View Of Steering Linkage ("C/K" Series - "I" Beam Axle)**  
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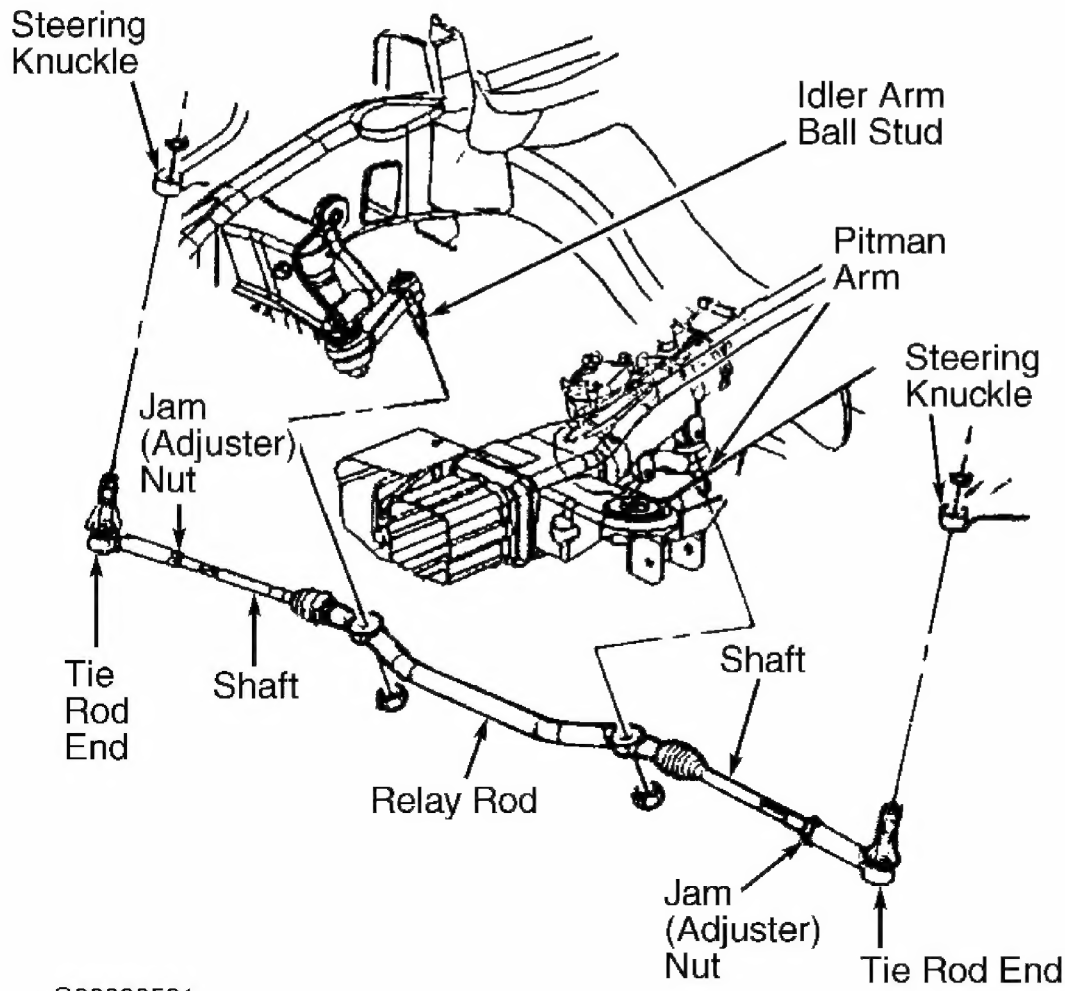


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**Fig. 3: Exploded View Of Steering Linkage ("C/K" Series - Old Style)**  
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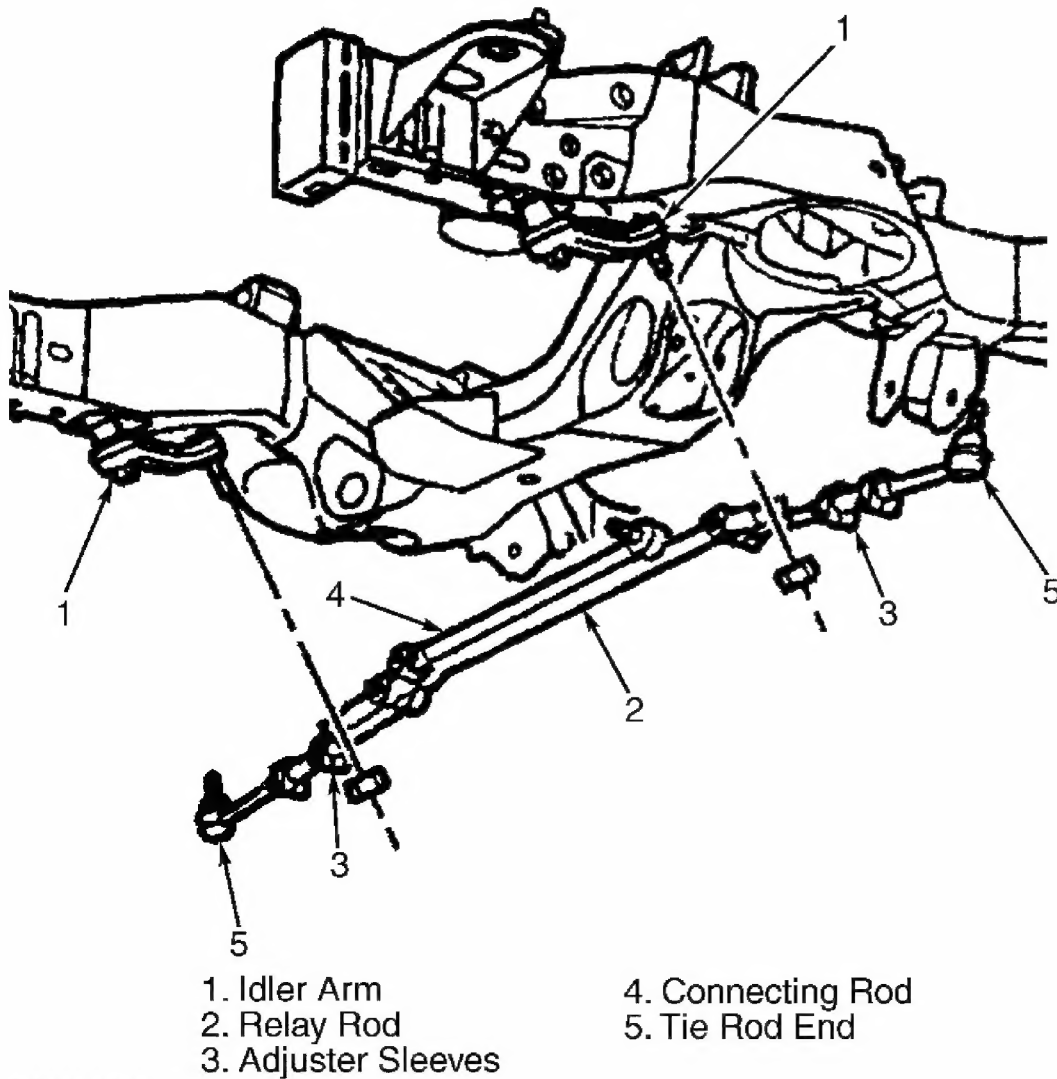
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**Fig. 4: Exploded View Of Steering Linkage ("C/K" Series - New Style)**  
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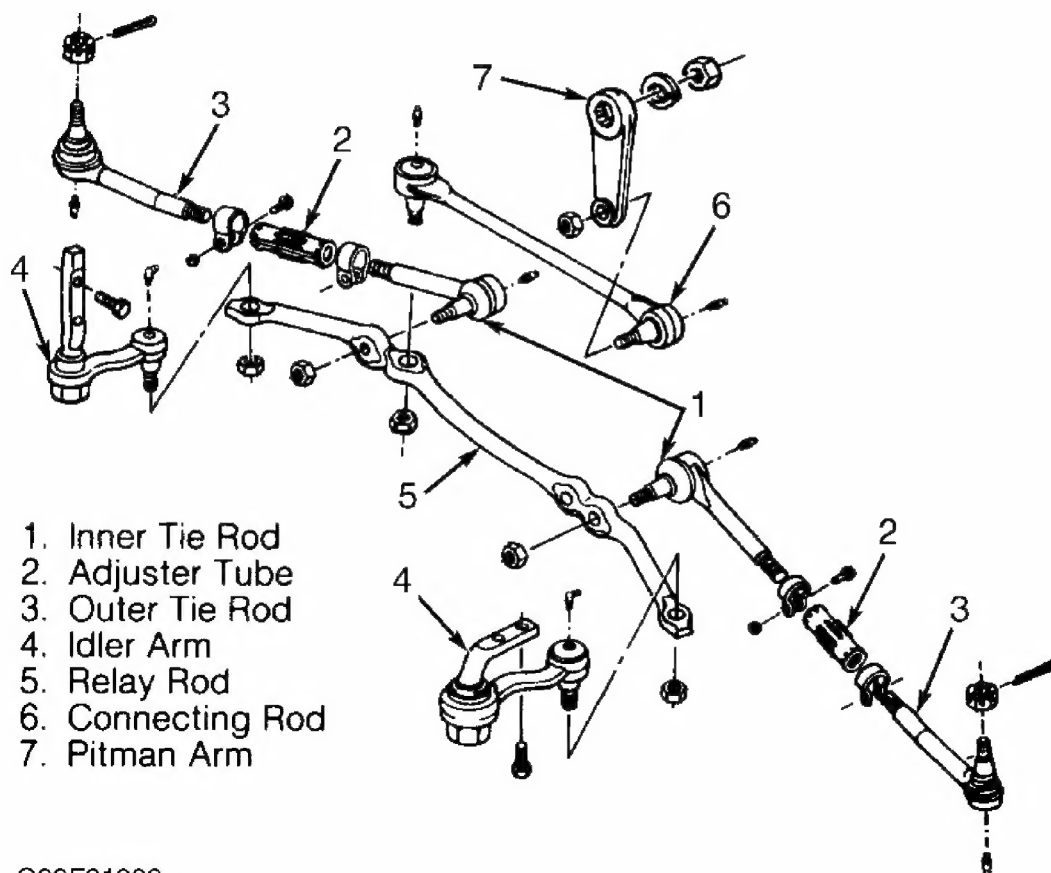


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**Fig. 5: Exploded View Of Steering Linkage ("G" Series)**  
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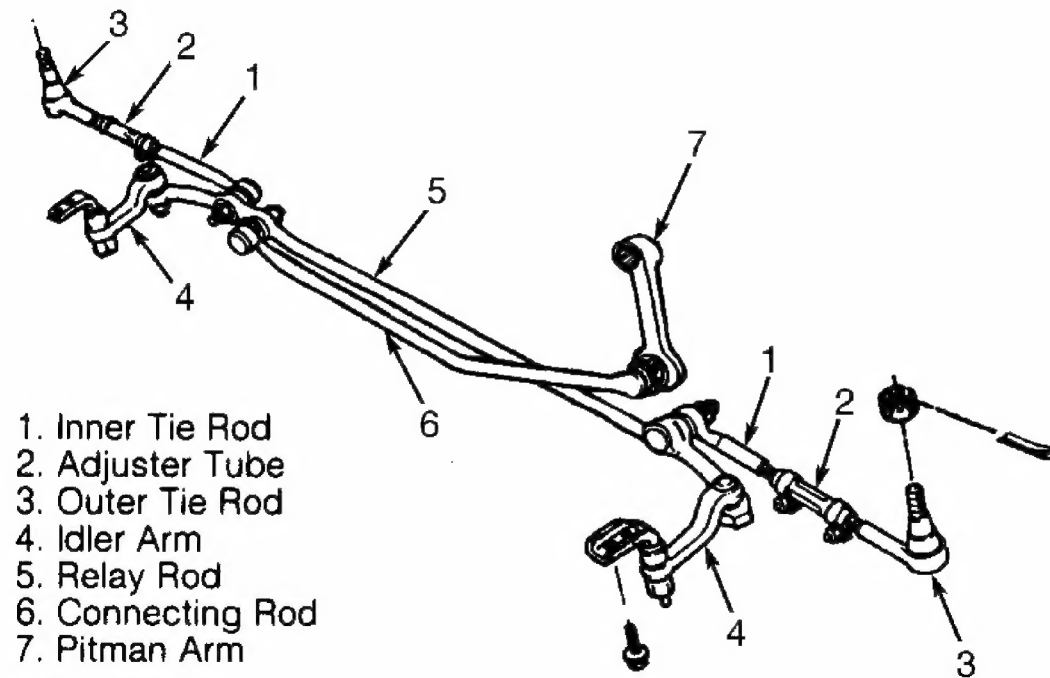


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**Fig. 6: Exploded View Of Steering Linkage ("L" Series)**  
**Courtesy of GENERAL MOTORS CORP.**

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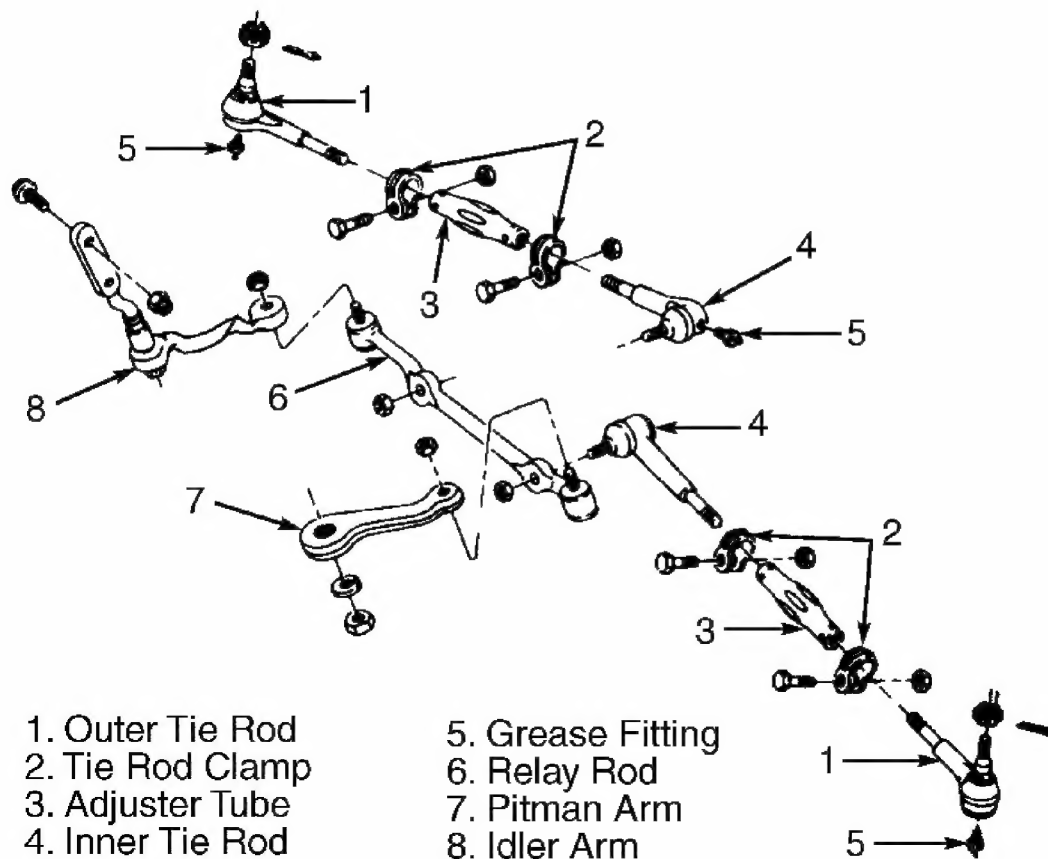


**Fig. 7: Exploded View Of Steering Linkage ("M" Series)**  
**Courtesy of GENERAL MOTORS CORP.**



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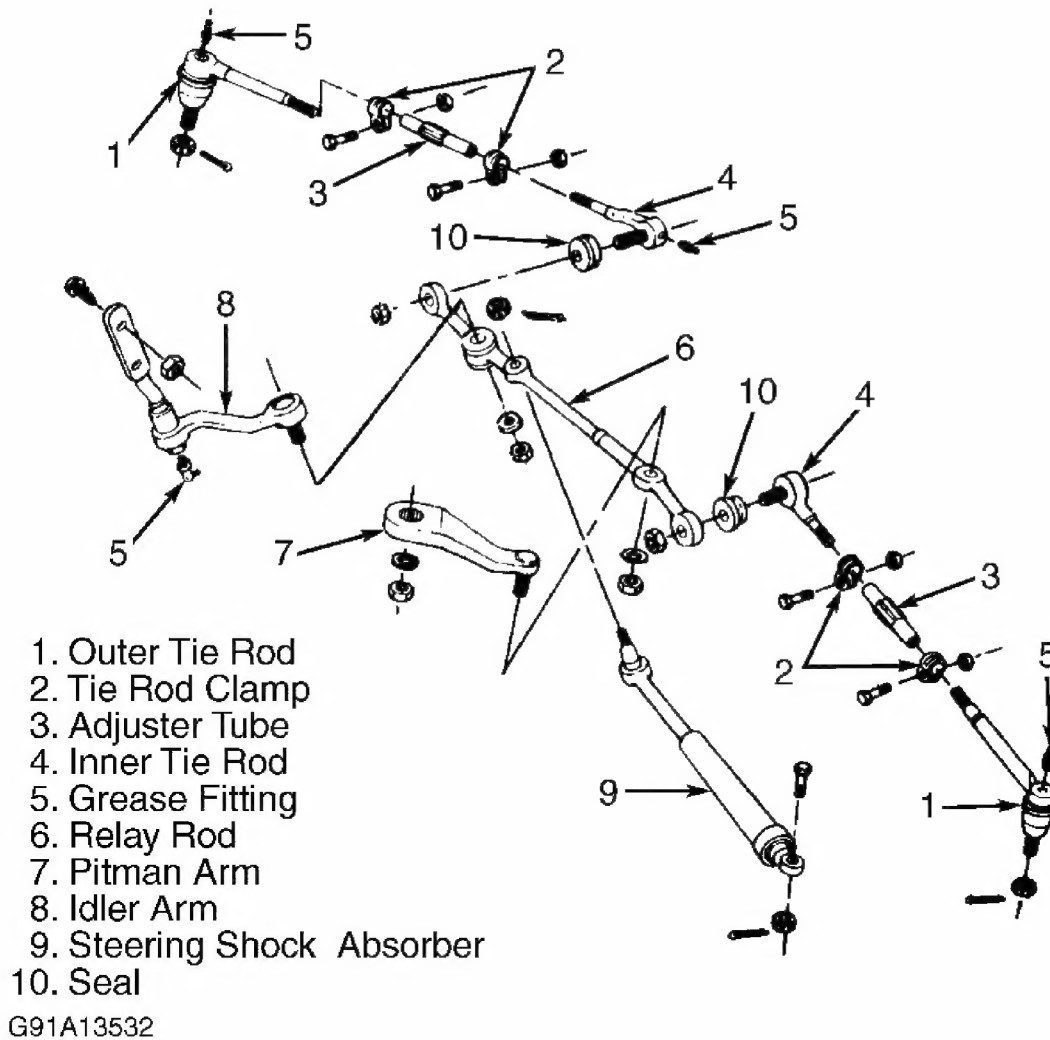


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**Fig. 8: Exploded View Of Steering Linkage ("S" Series)**  
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**Fig. 9: Exploded View Of Steering Linkage ("T" Series)**  
Courtesy of GENERAL MOTORS CORP.

## LUBRICATION

### FLUID TYPE

Manufacturer recommends General Motors Power Steering Fluid (1050017) or an equivalent. Failure to use proper fluid will cause hose and seal damage.

### FLUID LEVEL CHECK

To check fluid level, run engine until power steering fluid reaches normal operating temperature (about 170°F (77°C)). Turn engine off. Remove fluid reservoir cap, and check level gauge. On models with remote reservoir, fluid level should be 1/2-1" from top of reservoir with wheels turned fully left. Add fluid through fluid reservoir cap as necessary,

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and recheck fluid level. DO NOT overfill system.

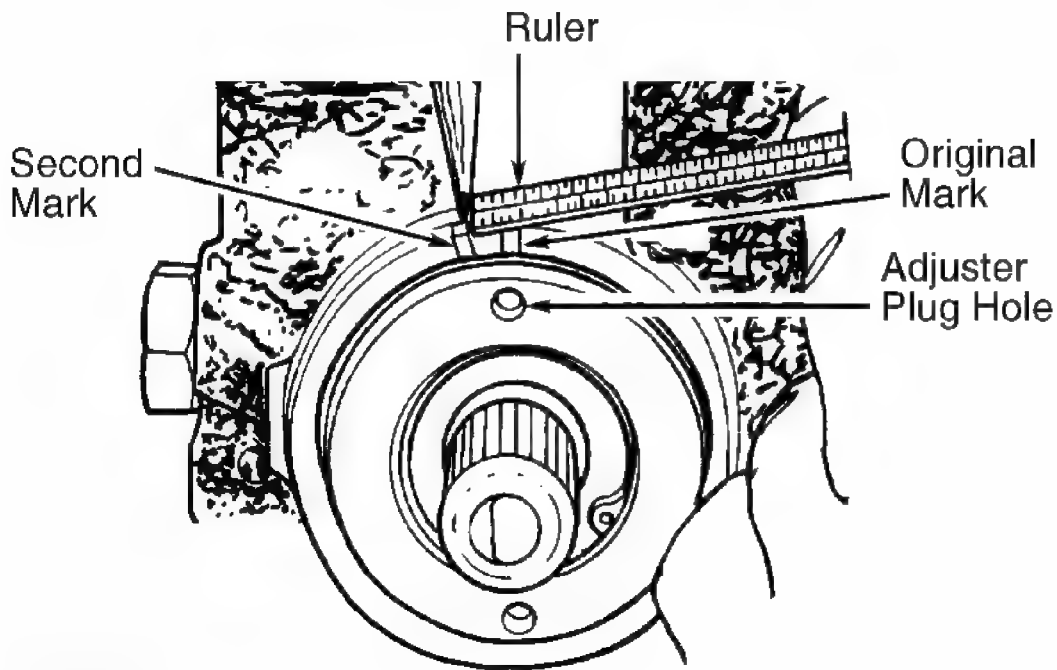
### HYDRAULIC SYSTEM PRESSURE BLEEDING

1. Fill reservoir to correct level. Attach Power Steering Bleeder Adapter (J-43485) onto Metal Mighty Vac (J-35555), and install. Apply 10 psi ( $.693 \text{ kg/cm}^2$ ) vacuum. Wait 5 minutes. Typical vacuum drop is 1.0-1.5 psi ( $.071\text{-.}102 \text{ kg/cm}^2$ ). If vacuum does not remain steady, go to next step. If vacuum remains steady, go to step 3.
2. Remove hoses from pump. Install plugs (supplied with bleeder adapter) into ports. Attach bleeder adapter and Mighty Vac. Apply 10 psi ( $.693 \text{ kg/cm}^2$ ) vacuum. If vacuum drops again, repair or replace pump. If vacuum holds steady, continue to check other parts of steering system.
3. Remove Mighty Vac and adapter. Start engine, and allow to idle. Turn off engine, and verify fluid level. Repeat until fluid stabilizes. Start engine, and allow to idle. Turn steering wheel 180-360 degrees in both directions, 5 times.
4. Switch ignition off, and verify fluid level. Reattach Mighty Vac and adapter. Apply 10 psi ( $.693 \text{ kg/cm}^2$ ) vacuum. Wait 5 minutes. Remove Mighty Vac and adapter. Verify fluid level.

### ADJUSTMENTS

#### WORM BEARING PRELOAD

1. Remove steering gear from vehicle, and mount in vise, before performing preload adjustments. See **STEERING GEAR** under REMOVAL & INSTALLATION. Remove worm bearing adjuster lock nut. See **Fig. 1**. Using spanner wrench, turn adjuster plug clockwise until plug is seated in housing. Torque should be about 21-23 ft. lbs. (28-31 N.m).
2. Make index mark on housing even with one hole in adjuster plug. See **Fig. 10**. Measure back 1/2" (13 mm) counterclockwise from first index mark. Mark housing with second index mark. Rotate adjuster plug counterclockwise until hole in adjuster plug aligns with second index mark on housing. Install and tighten adjuster plug lock nut. Ensure adjuster plug remains in position.



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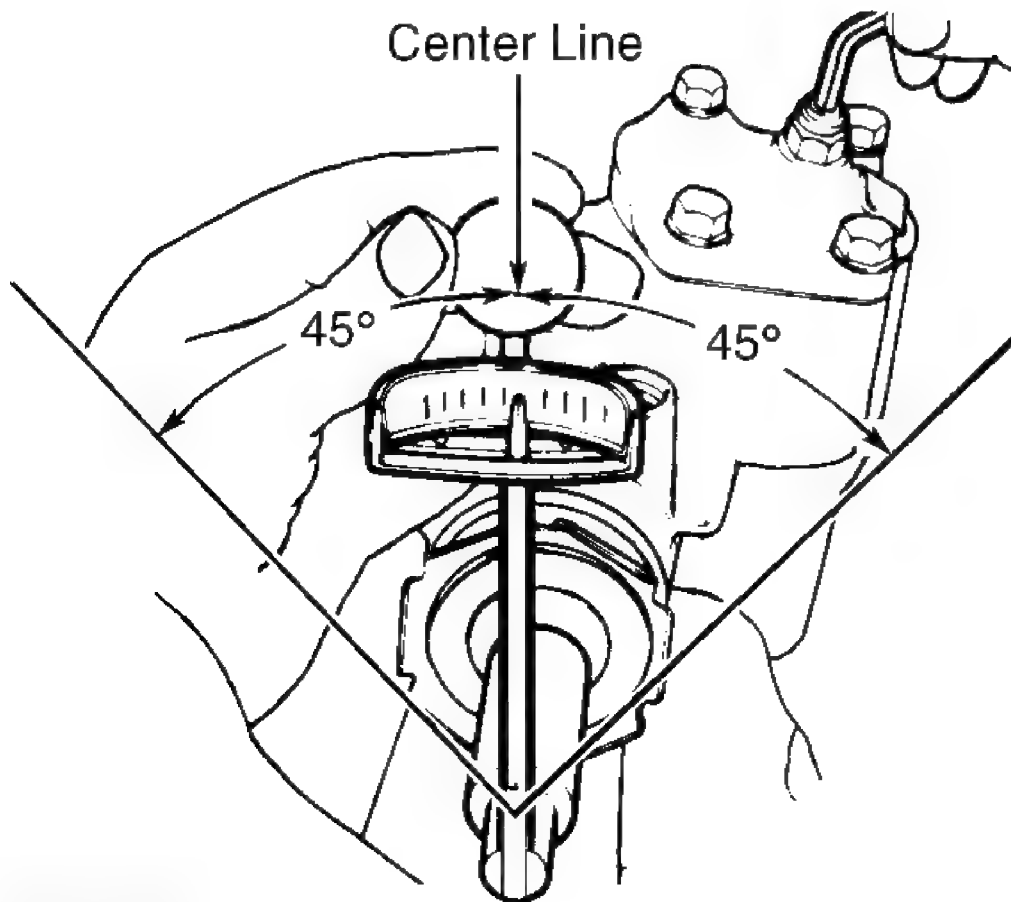
**Fig. 10: Measuring Worm Bearing Preload**  
Courtesy of GENERAL MOTORS CORP.

#### OVER-CENTER PRELOAD

**NOTE:** Adjust worm bearing preload before performing over-center preload adjustment.

1. With worm bearing preload adjusted, rotate stub shaft back and forth to drain fluid. Loosen adjuster lock nut. Turn pitman shaft adjuster screw counterclockwise until screw is fully extended. Turn pitman shaft adjuster screw clockwise one full turn.
2. Rotate stub shaft from stop to stop while counting number of turns. Starting at either stop, turn stub shaft back 1/2 total number of turns. This is center of gear. Make sure that flat on stub shaft faces upward, and is parallel with side cover. Align pitman shaft master spline with adjuster screw.
3. Measure gear over-center torque by rotating torque wrench attached to stub shaft in 90-degree arc, 45 degrees on each side of center. See **Fig. 11**. Stub shaft must rotate smoothly. Record worm bearing preload measured on or near center. Measurement must be 6-15 INCH lbs. (.7-1.7 N.m) with worm and ball nut installed. If torque is outside of range, readjust or repair gear as needed.
4. To obtain correct preload torque, adjust over-center torque by turning pitman shaft adjuster screw clockwise. Add 6-10 INCH Lbs. (.7-1.1 N.m) to previously measure

worm bearing preload torque. Tighten adjuster lock nut to specification. See **TORQUE SPECIFICATIONS** .



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**Fig. 11: Adjusting Over-Center Preload**  
Courtesy of GENERAL MOTORS CORP.

## **TROUBLE SHOOTING**

**NOTE:** See appropriate table in TROUBLE SHOOTING article in GENERAL INFORMATION.

## **SYSTEM TESTS**

### **HYDRAULIC SYSTEM PRESSURE TEST**

1. Ensure belt tension is correct. Disconnect high pressure line from power steering pump.

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Connect Power Steering Pressure Tester (J-5176-E) hose to power steering pump fitting. Connect other hose from valve side of tester to steering gear inlet.

2. Open valve on pressure gauge. Check fluid level and add fluid as necessary. Check for possible leaks at pressure gauge connections. Bleed air from system. See **HYDRAULIC SYSTEM PRESSURE BLEEDING** under LUBRICATION. Run engine until fluid reaches normal operating temperature of 150-170°F (66-77°C). Check fluid level and add fluid as necessary.
3. Note pressure reading with valve open and engine idling. Pressure should be correct pressure indicated in **PRESSURE TEST SPECIFICATIONS** . If pressure exceeds 200 psi (14 kg/cm<sup>2</sup> ), check hoses for restrictions and poppet valve for proper assembly.

**CAUTION: To prevent pump damage, Do not hold gauge valve closed for more than 5 seconds.**

4. Completely close and open valve 3 times. Record highest reading each time. Readings should be within specification. See **PRESSURE TEST SPECIFICATIONS** table.
5. If pressure readings are within specification and within 50 psi (4 kg/cm<sup>2</sup> ) of each other, pump is operating properly.
6. If readings are within specification but not within 50 psi (4 kg/cm<sup>2</sup> ) of each other, flow control valve in pump is sticking. Remove valve, but DO NOT disassemble it. Clean valve. Flush system if dirty.
7. If pressure is constant but more than 100 psi (7 kg/cm<sup>2</sup> ) less than specification, clean or replace flow control valve in pump. If readings are still low, replace pump.
8. If pressure readings are as specified, turn steering wheel from stop to stop with valve open. Record highest pressure with wheels at both stops. If highest pressure is not equal to highest pressure recorded in step 2 , steering gear is leaking internally. Repair or replace assembly.
9. Turn engine off. Remove tester. Reconnect pressure hose. Check fluid level. Bleed hydraulic system. See **HYDRAULIC SYSTEM PRESSURE BLEEDING** under LUBRICATION.

### PRESSURE TEST SPECIFICATIONS

Application	Idle Pressure - psi (kg/cm <sup>2</sup> )	Relief Pressure - psi (kg/cm <sup>2</sup> )
"C" Series (New Style) - 1500	80-150 (6-11)	1425-1525 (100-108)
"C" Series (New Style) - 2500	80-150 (6-11)	1350-1450 (95-102)
"C" Series (Old Style) - 1500/2500 & "K" Series	80-125 (6-9)	1425-1525 (100-108)
"C" Series - 3500	80-125 (6-9)	1465-1515 (103-107)

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"G" Series	80-125 (6-9)	1425-1525 (100-108)
"L" & "M" Series	No Greater Than 150 (11)	1350-1450 (95-102)
"S" & "T" Series	80-125 (6-9)	1100-1200 (77-84)

## REMOVAL & INSTALLATION

### STEERING GEAR

**NOTE:** Before disconnecting intermediate shaft from gear, ensure vehicle wheels are straight ahead and lock steering column through column access hole, using Steering Column Anti-Rotation Pin (J-42640). Failure to do so will cause damage to clockspring.

#### Removal & Installation ("C", "G" & "K" Series)

1. Raise and support vehicle. Remove engine protection shield, if necessary. Remove hoses from steering gear, and plug/cap openings. Disconnect intermediate shaft from gear.
2. Remove pitman arm from steering gear. See **PITMAN ARM** . Remove steering gear fasteners, and remove gear.
3. To install, reverse removal procedure. Tighten fasteners to specification. See **TORQUE SPECIFICATIONS** . Fill reservoir (if necessary). Bleed air from system. See **HYDRAULIC SYSTEM PRESSURE BLEEDING** .

#### Removal & Installation ("L" Series)

1. Disconnect negative battery cable. Remove air cleaner assembly, and disconnect MAF/IAT sensor. Remove upper fan shroud. Disconnect intermediate shaft from gear. Disconnect power brake booster outlet hose from gear, and cap/plug openings. Disconnect power steering cooler pipe from gear.
2. Remove pitman arm from steering gear. See **PITMAN ARM** . Remove steering gear fasteners, and remove from vehicle.
3. To install, reverse removal procedure. Tighten fasteners to specification. See **TORQUE SPECIFICATIONS** . Fill reservoir (if necessary). Bleed air from system. See **HYDRAULIC SYSTEM PRESSURE BLEEDING** .

#### Removal & Installation ("M" Series)

1. Raise and support vehicle. Remove front wheels. Remove pitman arm-to-connecting rod nut. Remove stabilizer bar links, and rotate stabilizer bar downward. Lower vehicle.
2. Disconnect negative battery cable. Remove air cleaner, and disconnect MAF/IAT

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electrical connector. Remove upper fan shroud.

3. Disconnect intermediate shaft from steering gear. Disconnect steering cooler hose and brake booster from gear. Raise vehicle. Remove gear mounting bolts. Lower vehicle. Remove gear. Remove pitman arm from gear. See **PITMAN ARM** .
4. To install, reverse removal procedure. Tighten fasteners to specification. See **TORQUE SPECIFICATIONS** . Fill reservoir (if necessary). Bleed air from system. See **HYDRAULIC SYSTEM PRESSURE BLEEDING** .

### Removal ("S" & "T" Series)

1. Remove air cleaner assembly and MAF (if necessary). Remove intermediate shaft from steering gear. Remove power steering hoses from gear, and cap/plug openings.
2. Remove lower intermediate shaft coupling bolt. Mark shaft coupling-to-steering shaft relationship. Remove shaft coupling from steering shaft. For "S" Series, go to next step. For "T" Series, go to step 4 .
3. Remove pitman arm. See **PITMAN ARM** . Remove steering gear fasteners, and remove from vehicle.
4. For "T" Series, raise vehicle. Remove steering linkage shield. Remove differential carrier shield. Remove pitman arm ball stud cotter pin and nut from relay rod. Disconnect pitman arm using Steering Linkage & Tie Rod Puller (J-24319-B). Remove steering gear fasteners, and remove from vehicle. Remove pitman arm. See **PITMAN ARM** .

### Installation ("S" Series)

To install, reverse removal procedure. Tighten fasteners to specification. See **TORQUE SPECIFICATIONS** . Fill reservoir (if necessary). Bleed air from system. See **HYDRAULIC SYSTEM PRESSURE BLEEDING** .

### Installation ("T" Series)

1. Install pitman arm. See **PITMAN ARM** . Install steering gear, and tighten bolts to specification. See **TORQUE SPECIFICATIONS** .
2. Install relay rod onto pitman arm ball stud. Seat taper using Steering Linkage Installer (J-29193 or J-29194), and tighten to 48 ft. Lbs. (62 N.m). Remove installer. To complete installation, reverse removal procedure. Tighten all fasteners to specification. Fill reservoir (if necessary). Bleed air from system. See **HYDRAULIC SYSTEM PRESSURE BLEEDING** under LUBRICATION.

## POWER STEERING PUMP

### Removal ("C" & "K" Series)

1. Remove air cleaner outlet duct and MAP/IAT electrical connectors. Remove TCM and connectors. Remove inlet hose from radiator. Remove upper fan shroud. Remove drive



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belt. Remove pump pulley using Power Steering Pump Pulley Remover (J-25034-C).

2. Remove filler neck from pump, if equipped. Remove hoses from pump. Remove nut from rear of pump. Remove bolts from front of pump. Remove mounting bracket fasteners, and pull bracket forward (if equipped). Remove pump.

### **Removal ("G" Series)**

1. Remove air cleaner assembly and connections. Remove air intake duct. Partially drain coolant, and remove surge tank. If equipped with 4.3L, 5.0L or 5.7L, remove following: bolt securing engine and transaxle oil level indicator to generator bracket, and engine oil fill tube-to-generator bracket bolt. On all "G" Series models, remove upper fan shroud.
2. On models with 4.3L, 5.0L or 8.1L engines, use Fan Clutch Wrench & Spanner (J-41240). On models with 6.5L engines, use Fan Clutch Wrench (J-41240-5A) and Fan Clutch Wrench & Spanner (J-41240). On all "G" Series models, remove drive belt. Remove pump pulley using Power Steering Pump Pulley Remover (J-25034-C).
3. Disconnect pressure/return hoses from pump. Disconnect reservoir outlet hose from pump, and cap/plug openings. Remove pump fasteners. Remove mounting bracket fasteners, and pull bracket forward. Remove pump from vehicle.

### **Removal ("L" & "M" Series)**

1. Disconnect negative battery cable. Remove air cleaner assembly, and disconnect MAF/IAT electrical connector. Remove drive belt. Remove power steering pump pulley using Power Steering Pump Pulley Remover (J-25034-C).
2. Disconnect inlet hose from brake booster. Disconnect cooler hose from power steering pump. Disconnect remote reservoir hose from power steering pump. Raise and support vehicle. Remove power steering pump rear mounting bracket nut.
3. Lower vehicle. Loosen accessory bracket fasteners, and pull bracket forward. Remove pump mounting bolts. Remove pump from vehicle, and remove brake booster inlet hose.

### **Removal ("S" & "T" Series - 2.2L Engine)**

1. Remove air intake duct assembly. Disconnect coolant recovery hose from lower fan shroud. Remove upper fan shroud. Remove hoses from pump, and cap/plug. Remove drive belt.
2. Remove fan clutch from coolant pump using Fan Clutch Wrench (J-41240). Remove power steering pump pulley using Power Steering Pump Pulley Remover (J-25034-C). Disconnect A/C compressor electrical connection. Remove A/C compressor. Remove power steering pump fasteners, and remove.

### **Removal ("S" & "T" Series - 4.3L Engine)**

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1. Remove air cleaner and MAF sensor. Remove air intake duct assembly. Disconnect coolant recovery hose from lower fan shroud. Remove upper fan shroud. Remove hoses from pump, and cap/plug. Remove drive belt.
2. Remove fan clutch from coolant pump using Fan Clutch Wrench (J-41240). Remove power steering pump pulley using Power Steering Pump Pulley Remover (J-25034-C).
3. Disconnect pressure hose from steering gear. Disconnect cooler hose from power steering pump. Remove reactor tube. Remove pump filler neck tube. Remove pump rear mounting bracket nut from engine stud. Remove pump front mounting bolts. Loosen mounting bracket fasteners, and pull bracket forward. Remove pump.

### Installation (All Models)

To install, reverse removal procedure. On "G" Series models with 4.3L, 5.0L and 5.7L engines, apply RTV sealant (GM P/N 12346286) to top end of oil level indicator tube, at joint. Use Power Steering Pump Pulley Installer (J-25033-C) to install pump pulley. Ensure pulley is flush against power steering pump shaft, with allowable variance of .010" (.25 mm). Tighten fasteners to specification. See **TORQUE SPECIFICATIONS**. Fill reservoir (if necessary). Bleed air from system. See **HYDRAULIC SYSTEM PRESSURE BLEEDING**.

### INNER & OUTER TIE ROD ENDS

#### Removal (Except "I" Beam Axle)

Raise and support vehicle. Remove cotter pins and outer tie rod end nuts. See **Fig. 3 -Fig. 9**. Remove inner tie rod end nuts. On "L", "M", "S" and "T" Series, use Tie Rod Puller (J-6627-A) to remove inner tie rod from relay rod. Using Universal Steering Linkage Puller (J-24319-B), remove outer tie rod ball studs from steering knuckle. Use same tool to separate inner tie rod ball studs from relay rod (for "C", "G" and "K" Series). Loosen adjuster tube clamp bolts and clamps. Unscrew and remove tie rod ends from adjuster tube.

#### Installation (Except "I" Beam Axle)

1. Lubricate tie rod end threads with chassis lubricant before installing. Install inner and outer tie rod ends onto adjuster tube. Inner and outer tie rod end threads must be adjusted equally within 3 threads. Install adjuster clamps and clamp bolts. Ensure clamps are positioned between locating dimples on ends of adjuster tube.
2. Tie rod ends must rotate full travel and travel must be maintained during clamp tightening. Slot in adjuster tube and slot in clamp must be properly positioned.
3. Install inner tie rod ends onto relay rod ensuring seal is on ball stud. Tighten Steering Linkage Installer (J-29193 or J-29194) to 40 ft. lbs. (54 N.m) to seat tapers. Install and tighten NEW inner tie rod end-to-relay rod nuts. Install outer tie rod end onto steering knuckle.

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**CAUTION:** When installing outer tie rod end nut, tighten nut to align cotter pin hole. Do not tighten nut more than an additional 1/6 turn to align cotter pin hole. Do not back off nut to insert cotter pin.

4. Install and tighten NEW outer tie rod end nut. Tighten bolts and nuts to specification. See **TORQUE SPECIFICATIONS** . Adjust toe-in. See appropriate SPECIFICATIONS & PROCEDURES article in WHEEL ALIGNMENT.

### Removal & Installation - "I" Beam Axle

Remove ball stud nut. See **Fig. 2** . Loosen nut on adjuster clamp. Remove ball stud from tie rod assembly. To install, reverse removal procedure. Install and tighten NEW outer tie rod end nut. Tighten bolts and nuts to specification. See **TORQUE SPECIFICATIONS** . Adjust toe-in. See appropriate SPECIFICATIONS & PROCEDURES article in WHEEL ALIGNMENT.

### TIE ROD ARM

#### Removal & Installation

Remove tie rod ball joint nut. See **Fig. 2** . Use Steering Linkage Puller (J-26813-B) to pull ball joint. Remove tie rod arm bolts, and remove tie rod. To install, reverse removal procedure. Install and tighten NEW ball stud nut. Tighten bolts and nuts to specification. See **TORQUE SPECIFICATIONS** . Adjust toe-in. See appropriate SPECIFICATIONS & PROCEDURES article in WHEEL ALIGNMENT.

### RELAY ROD

#### Removal

1. Raise and support vehicle. On "C" and "K" Series, remove engine protection shield (if equipped). Remove inner tie rod end nuts. See **Fig. 2 -Fig. 9** . Remove inner tie rod ends from relay rod (if equipped). See **INNER & OUTER TIE ROD ENDS** . On models without inner tie rods, remove tie rod end-to-steering knuckle nuts. Separate tie rod ends from steering knuckle.
2. On all models with shock absorber, remove shock absorber nut from relay rod (if equipped). See **SHOCK ABSORBER** . Using Universal Steering Linkage Puller (J-24319-01), remove shock absorber from relay rod (if equipped). Remove connecting rod nut, and remove connecting rod from relay rod (if equipped).
3. Remove relay rod end nuts from pitman arm and idler arm. Using Steering Linkage Puller (J-24319-01), remove pitman arm and idler arm from relay rod. Remove relay rod.

#### Installation

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Reverse removal procedure. Ensure seals are on ball studs. Using Steering Linkage Installer (J-29193 or J-29194), seat all tapers, except on Old Style "C" and "K" models, to 40 ft. lbs. (54 N.m). Seat Old Style "C" and "K" model tapers to 46 ft. lbs. (62 N.m). Tighten NEW nuts to specification. See **TORQUE SPECIFICATIONS** . Adjust toe-in. See appropriate SPECIFICATIONS & PROCEDURES article in WHEEL ALIGNMENT.

### IDLER ARM

#### Removal

Raise and support vehicle. On "C" and "K" Series, remove engine protection shield (if equipped). On "S" Series vehicles, remove steering linkage shield and differential carrier shield. On all vehicles, remove idler arm-to-frame nut and bolt. See **Fig. 2 -Fig. 9** . Remove idler arm nut and spring washer from relay rod. Using Steering Linkage Puller (J-24319-01 or J-24319-B), remove idler arm from relay rod. Remove idler arm.

#### Installation

To install, reverse removal procedure. Ensure seal is on ball stud. Using Steering Linkage Installer (J-29193 or J-29194), seat tapers, except on "S" Series, to 40 ft. lbs. (54 N.m). On "S" Series, seat taper to 60 ft. lbs. (82 N.m). Tighten NEW ball stud nuts to specification. See **TORQUE SPECIFICATIONS** . Adjust toe-in. See appropriate SPECIFICATIONS & PROCEDURES article in WHEEL ALIGNMENT.

### PITMAN ARM

#### Removal ("C", "K" & "S" - Without "I" Beam Axle)

1. Raise and support vehicle. On New Style "K" Series, remove differential carrier shield. On all styles, remove relay rod ball stud from pitman arm using Universal Steering Linkage Puller (J-24319-01 or J-24319-B). See **Fig. 3 -Fig. 9** . On "K" Series, remove steering gear. See **STEERING GEAR** .
2. Mark pitman arm-to-pitman shaft relationship. On Old Style "C" and "K" Series, remove pitman arm using Pitman Arm Puller (J-6632-01) or Universal Pitman Arm Puller (J-24319-01). On New Style "C" and "K" Series and "S" Series, use Pitman Arm Puller (J-6632-01) or Universal Pitman Arm Puller (J-29107-A).

#### Removal ("G", "L" & "M" Series)

Raise and support vehicle. Remove connecting rod from pitman arm using Universal Steering Linkage Puller (J-24319-B). On "M" Series, remove steering gear. See **STEERING GEAR** . Mark pitman arm-to-pitman shaft relationship, and remove pitman arm using Pitman Arm Puller (J-29107-A or J-6632-01).

#### Removal ("T" Series)

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Remove steering gear. See **STEERING GEAR** . Install gear into vise. Remove pitman arm using Pitman Arm Puller (J-29107-A or J-6632-01).

### Removal & Installation (Models With "I" Beam Axle)

1. Raise and support vehicle. Remove drag link from pitman arm ball stud. See **Fig. 2** . Remove pitman arm nut from steering gear shaft. Mark pitman arm-to-pitman shaft relationship. Use Pitman Arm Puller (J-6632-01) or Universal Pitman Arm Puller (J-29107-A) to remove pitman arm.
2. To install, reverse removal procedure. Use Steering Linkage Installer (J-29193 or 29194) to install pitman arm. Tighten to 46 ft. lbs. (62 N.m) to seat tapers. Tighten NEW nut to specification. See **TORQUE SPECIFICATIONS** .

### Installation (All Models - Without "I" Beam Axle)

To install, reverse removal procedure. Ensure seal is on pitman arm ball stud. Use NEW pitman arm nut. On "C", "K" and "S" Series, use Steering Linkage Installer (J-29193 or J-29194) to seat tapers to 46 ft. lbs. (62 N.m). On "G", "L" & "M" Series, use Steering Linkage Installer (J-29193 or J-29194) to seat taper to 40 ft. lbs. (54 N.m). Use NEW nut. Tighten fasteners to specification. See **TORQUE SPECIFICATIONS** . Adjust toe-in. See appropriate SPECIFICATIONS & PROCEDURES article in WHEEL ALIGNMENT.

## CONNECTING ROD

### Removal (Models With "I" Beam Axle)

Raise and support vehicle. Remove connecting rod nuts from pitman arm and steering arm. See **Fig. 3 -Fig. 9** . Using Universal Steering Linkage Puller (J-24319-01 or J-24319-B), remove connecting rod from pitman arm and steering arm. Mark position of adjuster tube and direction of bolt installation. Loosen adjuster tube clamp bolt and clamps. Unscrew and remove connecting rod ends from adjuster tube.

### Installation (Models With "I" Beam Axle)

1. Lubricate connecting rod end threads with chassis lubricant before installing. Install connecting rod ends to adjuster tube. Connecting rod end threads must be adjusted equally within 3 threads. Install adjuster clamps and clamp bolts. Slot in adjuster tube and slot in clamp must be properly positioned.
2. Connecting rod ends must rotate through full travel, and travel must be maintained during clamp tightening. Install connecting rod end to pitman arm, ensuring seal is on ball stud. Tighten Steering Linkage Installer (J-29193 or J-29194) to 40 ft. lbs. (54 N.m) to seat tapers. Install and tighten connecting rod-to-pitman arm nut.
3. Install connecting rod end to steering arm. Install and tighten connecting rod-to-steering arm nut. Tighten bolts and nuts to specification. See **TORQUE SPECIFICATIONS** . Adjust toe-in. See appropriate SPECIFICATIONS &

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### PROCEDURES article in WHEEL ALIGNMENT.

#### Removal & Installation (Models Without "I" Beam Axle)

1. Raise and support vehicle. Remove connecting rod nuts from pitman arm and relay rod. See **Fig. 3 -Fig. 9** . Using Steering Linkage Puller (J-24319-01 or J-24319-B), remove connecting rod from pitman arm and relay rod.
2. To install, reverse removal procedure. Ensure seal is on ball stud. Using Steering Linkage Installer (J-29193 or J-29194), seat tapers to 40 ft. lbs. (54 N.m). Tighten NEW nuts to specification. See **TORQUE SPECIFICATIONS** .

### SHOCK ABSORBER

#### Removal

1. On "C" and "K" Series, go to next step. On "S" and "T" Series, raise and support vehicle. Remove steering linkage shield. Remove differential carrier shield.
2. Remove shock absorber nut from relay rod. Using Universal Steering Linkage Puller (J-24319-01 or J-24319-B), remove shock absorber from relay rod. Remove shock absorber-to-frame nut and bolt. Remove shock absorber.

#### Installation

Reverse removal procedure. Ensure seal is on ball stud. On "C" and "K" Series, use Steering Linkage Installer (J-29193 or J-29194) to seat tapers to 46 ft. lbs. (62 N.m). On "S" and "T" Series, seat tapers to 40 ft. lbs. (54 N.m). Tighten NEW nuts to specification. See **TORQUE SPECIFICATIONS** .

### OVERHAUL

#### STEERING GEAR

##### Disassembly

1. Mount steering gear in vise, clamping onto mounting tab. Pitman shaft should be in vertical position. Insert punch through housing access hole to unseat retaining ring. See **Fig. 1** . Pry retaining ring out of groove in housing.
2. Rotate stub shaft counterclockwise to force housing end plug from housing. Remove seals and ring. Using Rack Piston Arbor (J-21552) and socket, remove rack piston end plug from rack piston.
3. Remove side cover bolts. Remove pitman shaft nut and spring washer from lower end of shaft retaining pitman arm. Remove pitman shaft lock nut. Remove side cover. Remove gasket from side cover.
4. Remove pitman shaft dust seal and rubber boot (if equipped). Using snap-ring pliers, remove pitman shaft lower retaining ring. Remove pitman shaft lower seals, rings and

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washer. Using Pitman Shaft Bearing Remover and Installer (J-6278), remove pitman shaft bearing from housing.

5. Insert Rack Piston Arbor (J-21552) into end of rack piston assembly until arbor seats into end of worm shaft. Threaded arbor will keep recirculating balls from falling out of rack piston. Rotate stub shaft counterclockwise, forcing rack piston onto arbor. Remove rack piston and arbor assembly. Ensure arbor is fully inserted so recirculating balls will not fall out.
6. Remove adjuster plug lock nut. Using spanner wrench, remove adjuster plug. Remove valve body, stub shaft, worm shaft, seal, bearing races and worm bearing assembly from housing. If further disassembly is required, see appropriate component under **OVERHAUL**.

### Inspection

Clean components using solvent, and blow dry. Avoid wiping valve components with cloth. Lint may cause binding of mechanism. DO NOT steam clean hydraulic parts.

### Reassembly

1. Lubricate components with power steering fluid before reassembly. Install valve body, stub shaft and worm shaft assembly into housing. See **Fig. 1**.
2. Place seal protector over stub shaft. Install adjuster plug until it seats against valve body. Remove seal protector from housing. Loosely install adjuster plug lock nut. Insert rack piston (with arbor to retain recirculating balls) into housing. Align worm shaft and rack piston. Turn stub shaft clockwise to engage worm shaft. Maintain pressure on arbor until worm shaft is fully engaged. Remove arbor.
3. Install NEW pitman shaft side cover gasket. Thread side cover onto adjuster screw until it bottoms. Back off 1/2 turn. Install pitman shaft so center sector gear tooth meshes with center groove in rack piston. Install side cover bolts.
4. Install adjuster screw lock nut halfway onto pitman shaft. Install rack piston end plug in rack piston. Install housing end plug seals, ring, end plug and retainer ring. Adjust worm shaft bearing preload and over-center preload. See **WORM BEARING PRELOAD** and **OVER-CENTER PRELOAD** under ADJUSTMENTS.

### ADJUSTER PLUG

#### Disassembly

Using snap-ring pliers, remove adjuster plug retaining ring. Remove adjuster plug washer and seal. Using screwdriver, pry up bearing retainer at raised area. Using Bearing Remover (J-8524-1) and Driver (J-7079-2), remove bearing from adjuster plug.

#### Inspection

Inspect bearings and races for scoring, pitting and wear. Inspect adjuster plug threads for

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damage.

### Reassembly

**NOTE:** Retainer projections must not extend beyond washer when retaining ring is seated. Adjuster plug washer must be free to rotate.

Using Bearing Remover (J-8524-1) and Driver (J-7079-2), install bearing into adjuster plug. Install bearing retainer. Lubricate seal with power steering fluid. Install adjuster plug seal, washer and retaining ring.

### WORM SHAFT, STUB SHAFT & VALVE BODY

#### Disassembly

1. Mark relationship of worm bearing races and bearing to worm shaft. Mark position of worm shaft notches to valve body. Remove worm shaft from valve body and stub shaft assembly. Remove stub shaft seal. Remove worm bearing races and bearing from worm shaft.

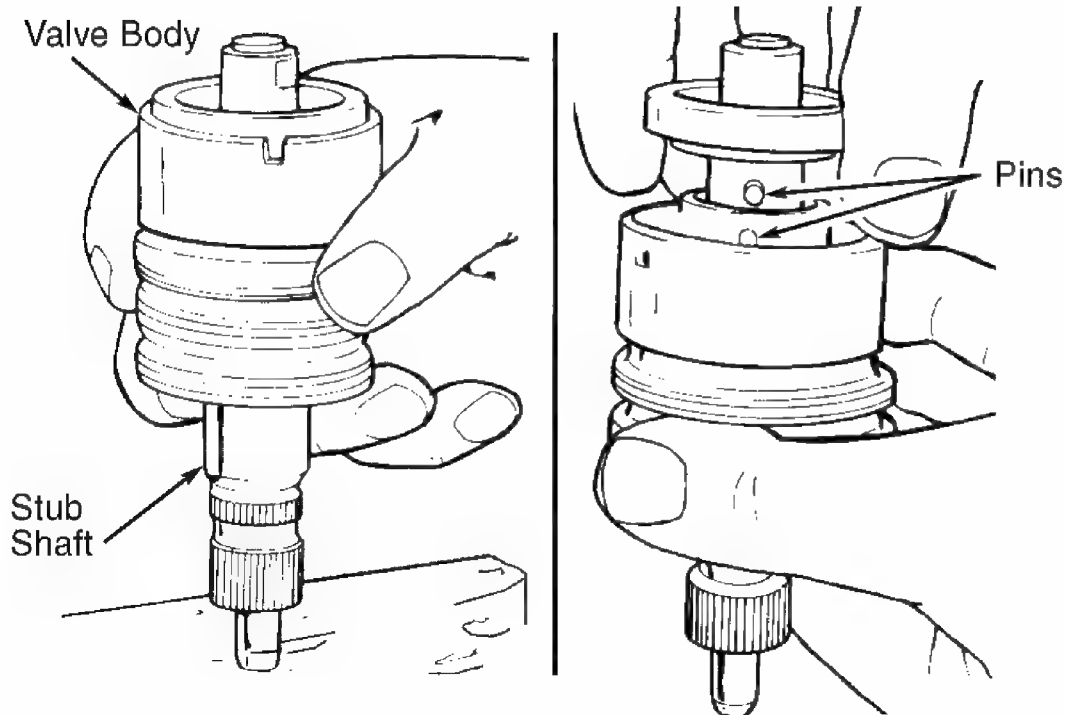
**CAUTION:** Do not pull shaft more than 1/4" (6 mm), or spool valve may become cocked in valve body.

2. Lightly tap end of stub shaft against wood block until shaft cap is free of valve body. Pull stub shaft outward until drive pin hole is visible. See **Fig. 12**.

**CAUTION:** Do not force stub shaft or valve spool out of valve body.

3. Disengage drive pin. Remove stub shaft from valve body. Rotate and remove valve spool from valve body. If binding occurs, realign valves.
4. Remove spool valve seal. Remove valve body rings and seals.





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**Fig. 12: Removing Stub Shaft From Valve Body**  
Courtesy of GENERAL MOTORS CORP.

#### Inspection

1. Clean components using solvent, and blow dry. Inspect stub shaft for nicks and burrs. Remove nicks and burrs using crocus cloth, if possible. Inspect shaft pin for wear and cracks.
2. Check valve spool fit in valve body. Remove nicks and burrs using crocus cloth if possible. Lubricate valve spool with power steering fluid. Rotate valve spool in valve body. If valve spool does not rotate freely, replace complete valve and stub shaft assembly.
3. Valve assembly is balanced during assembly. If replacing any components other than rings or seals, replace complete valve and stub shaft assembly.

#### Reassembly

1. Lubricate valve body components with power steering fluid. Install NEW rings and seals. Lubricate spool valve seals with power steering fluid and install onto valve spool. Carefully insert valve spool into valve body.
2. Push valve spool through valve body until locating pin hole is visible at opposite end of valve body, and valve spool is flush with notched end of valve body. Install stub shaft

into valve spool and valve body.

**CAUTION: Before installing assembled valve body into gear housing, ensure valve body stub shaft locating pin is fully engaged into stub shaft cap notch. Do not allow stub shaft to disengage from valve body pin.**

3. Align stub shaft locating pin with valve spool locating hole. Align notch in stub shaft cap with pin in valve body. Install stub shaft seal into valve body.
4. Install bearing and races on worm shaft, aligning marks made during disassembly. See **Fig. 1** . Install worm shaft onto valve body and stub shaft assembly, aligning notches made during disassembly.

## **RECIRCULATING BALLS**

### **Disassembly**

Remove ball guide clamp screws and clamps. Remove ball guides. Remove all recirculating balls from rack piston. See **Fig. 1** and **Fig. 13** .

### **Inspection**

Clean components using solvent, and blow dry. Inspect rack piston grooves for scoring. Inspect ball bearings for damage. If any ball bearings are damaged, replace entire set. Check ball guides for cracks or dented ends. Inspect rack piston teeth for chips, cracks, dents and scoring. If rack piston is damaged, replace rack piston and worm shaft as an assembly.

### **Reassembly**

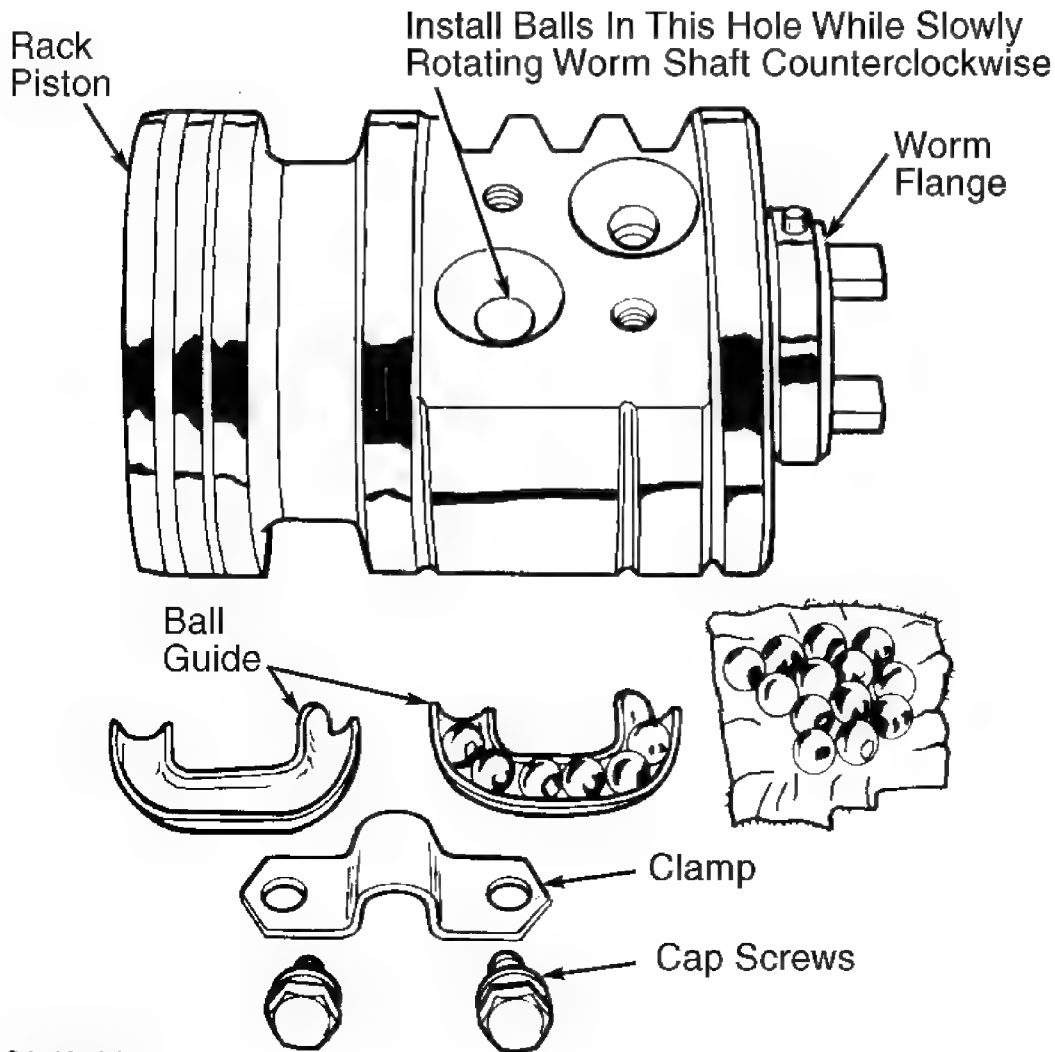
1. Lubricate seals and ring with power steering fluid and carefully install onto rack piston. Install worm shaft into rack piston until worm shaft touches piston shoulder. While turning worm shaft counterclockwise, insert ball bearings into rack piston.

**NOTE: Ensure light and dark colored balls are installed alternately. Black balls are .0005" (.013 mm) smaller than Silver balls.**

2. Install 6 balls in ball guide, alternating ball colors. Bearings in guide must be in sequence with bearings in rack piston. Hold balls in place with chassis lubricant. Install return ball guide assembly into position.
3. Install clamp. Tighten clamp screws. See **Fig. 13** . Insert Rack Piston Arbor (J-21552) into rack piston until it contacts worm shaft. Maintain pressure on arbor, and back worm shaft out of rack piston. DO NOT allow ball bearings to drop out.

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**Fig. 13: Installing Ball Bearing Into Rack Piston**  
Courtesy of GENERAL MOTORS CORP.

### POWER STEERING PUMP

#### Disassembly ("P" Type)

1. Using Power Steering Pulley Pump Remover (J-29785-A), remove pulley from shaft (if not previously removed). Remove union fitting and "O" ring. Remove reservoir retaining bolts. Remove reservoir and "O" rings from housing.
2. Using punch and screwdriver, remove end plate retaining ring. Remove end plate and pressure plate spring. See **Fig. 14** . Remove "O" ring, flow control valve, and spring. Using soft-face hammer, tap end of drive shaft to loosen pressure plate.
3. Remove pressure plate, pump ring, vanes, retaining ring, rotor, and thrust plate

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assembly from housing. Remove drive shaft. Pry drive shaft seal from housing. Remove dowel pins and seals.

### Inspection

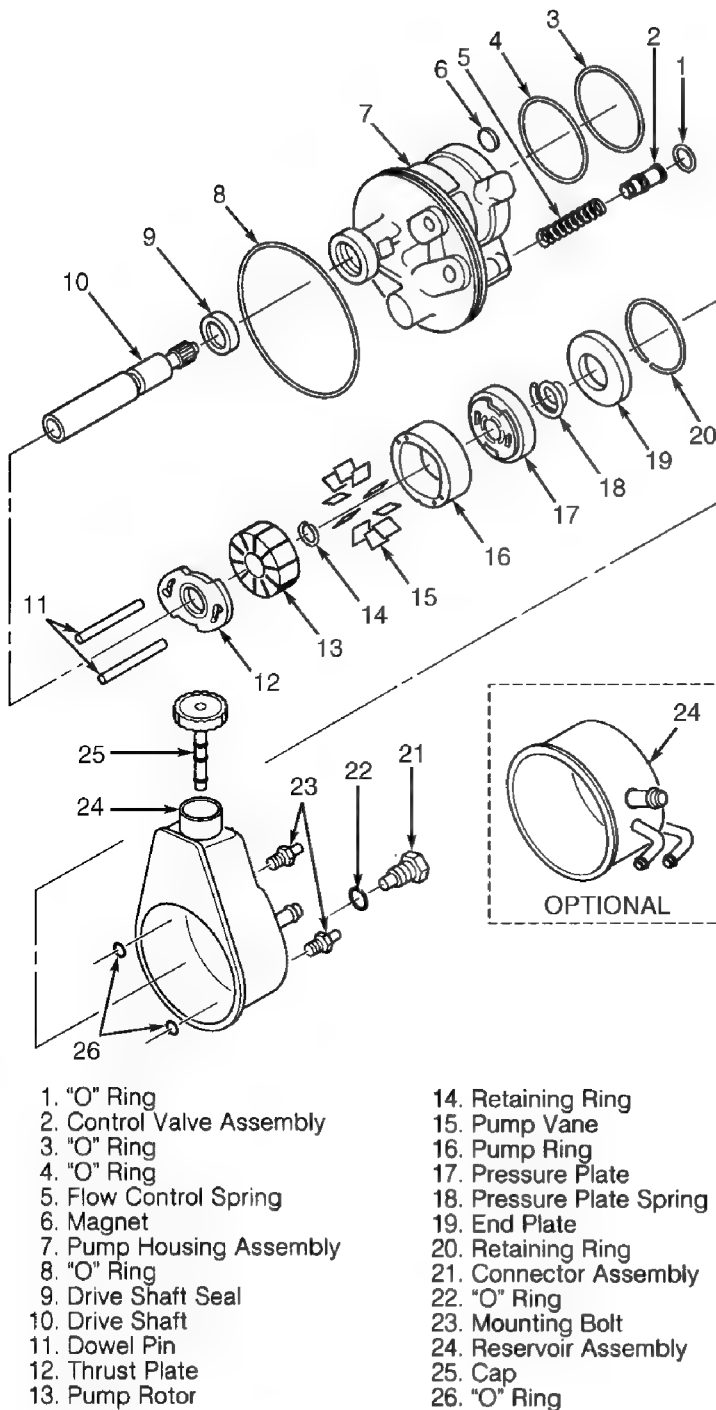
1. Clean all pump components with solvent and blow dry. Inspect flow control valve assembly for wear, scoring, burrs and other damage. Inspect seal bore for burrs, nicks and score marks.
2. Inspect machined surfaces of body for scratches or burrs. Check "O" ring mating surfaces. Inspect drive shaft for excessive wear.
3. Inspect pump ring for roughness. Check thrust plate and pressure plate for scoring and wear. Ensure vanes slide freely but fit snugly into slots. If vanes are loose in slots, replace rotor and/or vanes.

### Reassembly

1. Lubricate all "O" rings, seals, pump ring, rotor and vanes with power steering fluid. Using socket, press NEW drive shaft seal into housing.
2. Install dowel pins and all "O" rings. Install drive shaft and thrust plate. Install pump rotor into housing with counterbore facing drive shaft side of steering pump.
3. Install NEW drive shaft retaining ring, ensuring ring is seated in groove. Install vanes with rounded edges toward pump ring. Install pump ring and pressure plate. Install "O" ring, flow control valve, and spring.
4. Install pressure plate spring, end plate, and retaining ring. Install seals and reservoir. Install union fitting, "O" ring, and reservoir retaining bolts.

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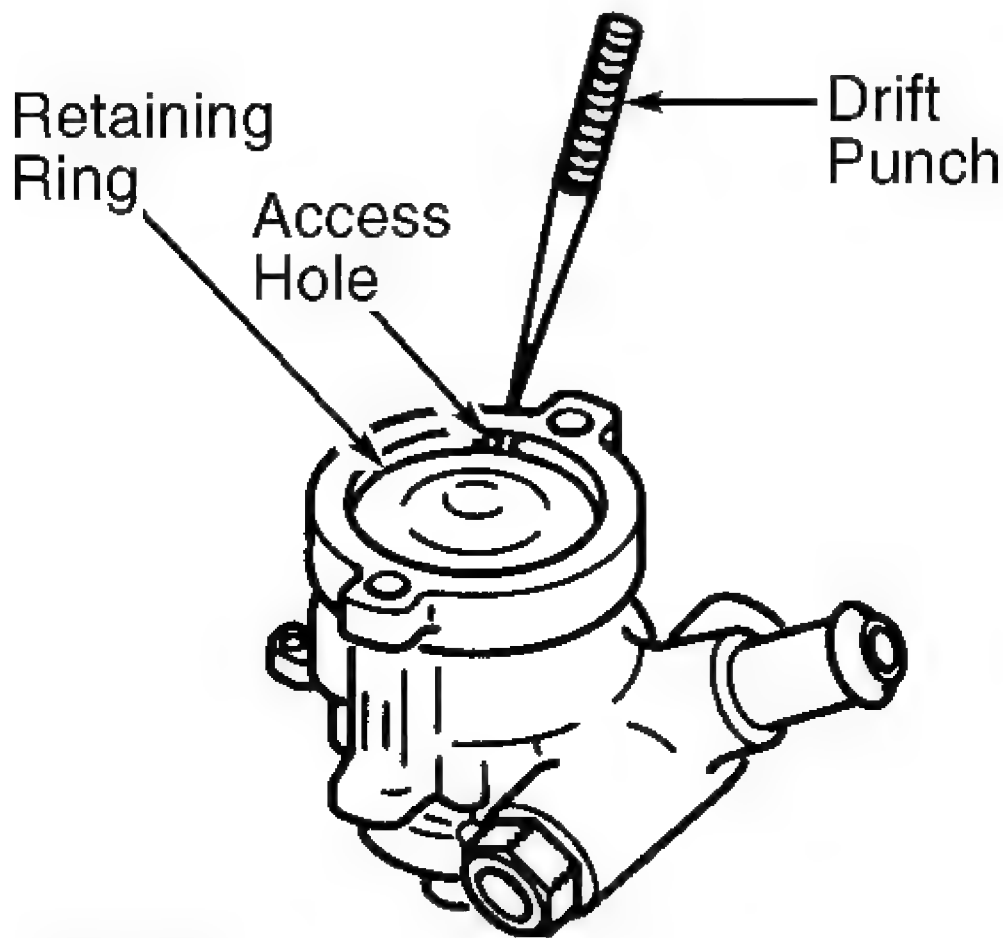
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**Fig. 14: Exploded View Of Power Steering Pump ("P" Type)**  
**Courtesy of GENERAL MOTORS CORP.**

### Disassembly ("CB" Type)

1. Remove pump assembly from vehicle. Remove retaining clips between reservoir and housing, and remove reservoir from housing.

2. Remove union fitting and "O" ring. Remove control valve assembly and flow control spring.
3. Protect drive shaft with shim stock and using a small chisel, cut drive shaft seal and remove. Using small drift punch, remove end cover retaining ring. See **Fig. 15** .



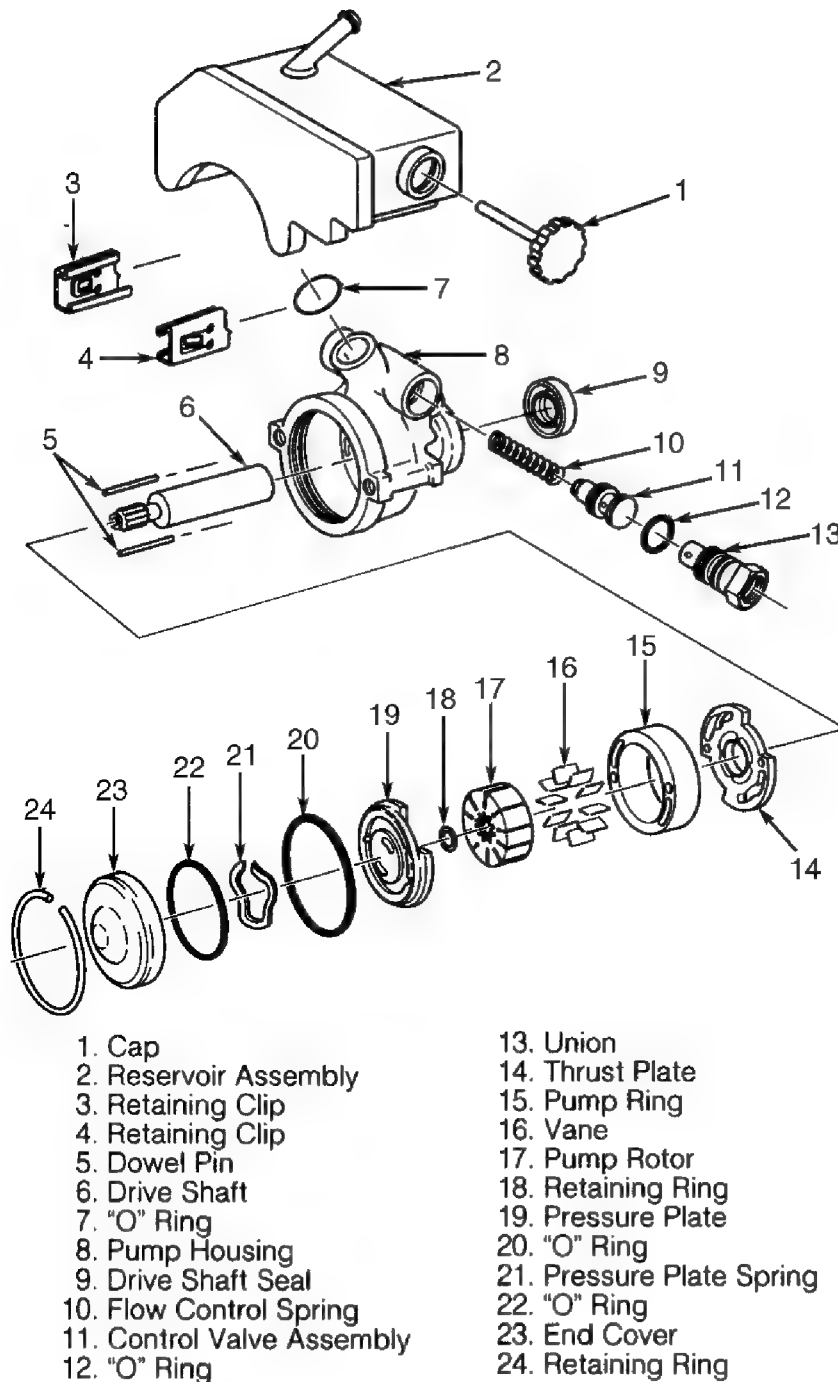
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**Fig. 15: Removing Retaining Ring ("CB" Type)**  
Courtesy of GENERAL MOTORS CORP.

4. Remove internal components of pump by gently pushing on drive shaft. See **Fig. 16** .

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**Fig. 16: Exploded View Of Power Steering Pump ("CB" Type)**  
**Courtesy of GENERAL MOTORS CORP.**

5. Remove "O" ring from pump housing. Remove locating dowel pins. Remove drive shaft seal (if not already removed). Remove end cover, pressure plate spring and "O" ring from pressure plate.
6. Remove pump ring and vanes from drive shaft subassembly. Remove retaining ring

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from drive shaft. Remove pump rotor and thrust plate from drive shaft.

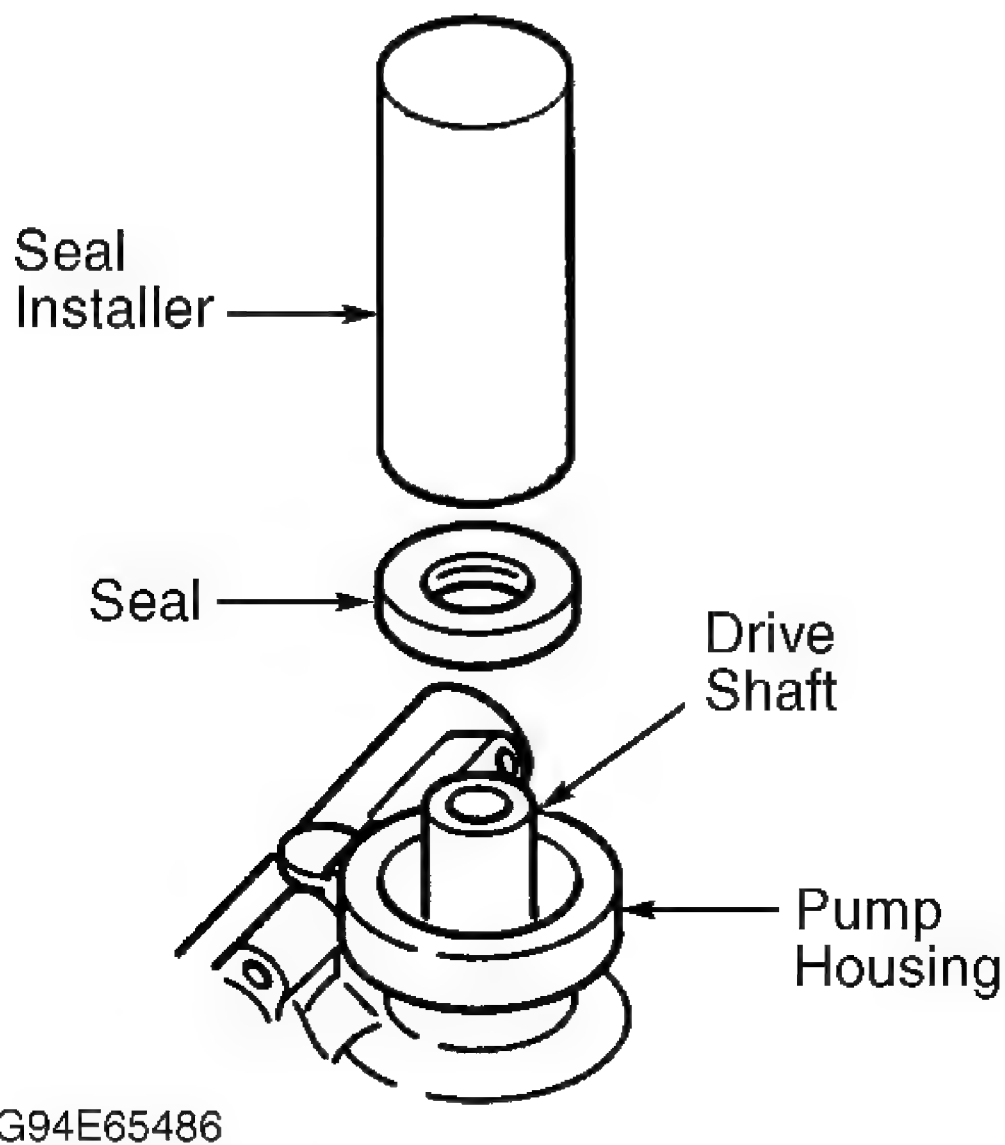
### Inspection

Clean all parts in power steering fluid and dry with compressed air. Inspect pressure plate, pump ring, vanes, thrust plate and drive shaft for scoring, pitting or chatter marks. Replace any damaged parts.

### Reassembly

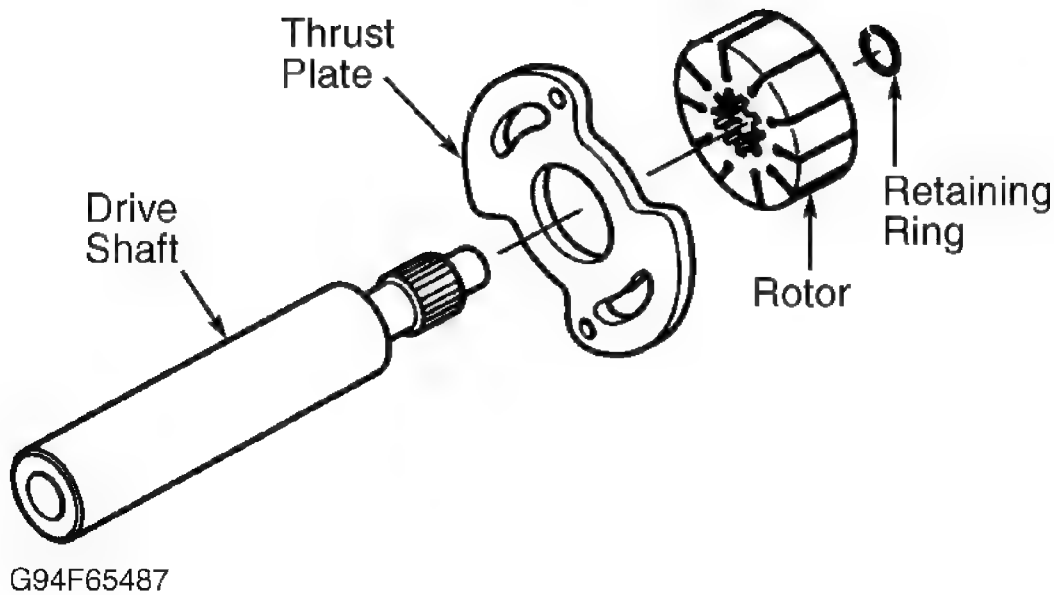
1. Lubricate NEW drive shaft seal with power steering fluid and drive seal into pump housing using Seal Driver (J-7728). See **Fig. 17** .





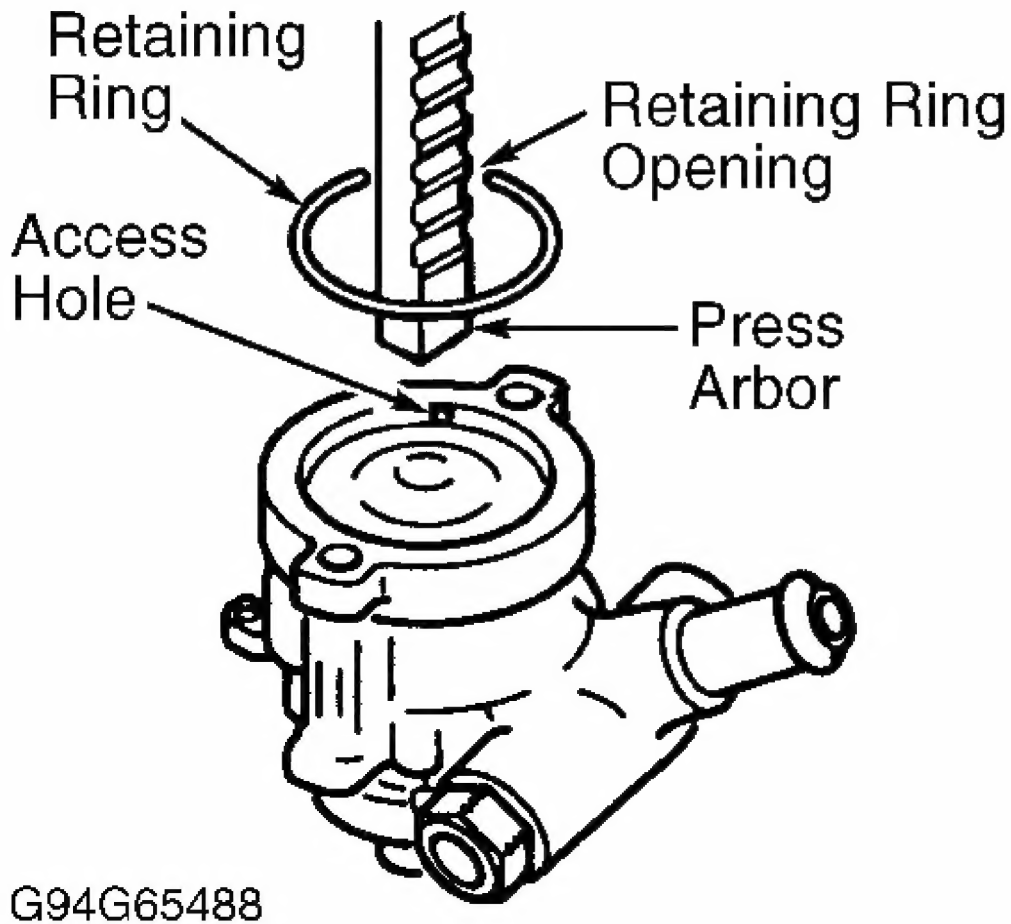
**Fig. 17: Installing Drive Shaft Seal**  
Courtesy of GENERAL MOTORS CORP.

2. Install pump ring dowel pins into pump housing. Assemble thrust plate and pump rotor onto drive shaft. Fit NEW retaining ring to shaft. See **Fig. 18** .



**Fig. 18: Assembling Drive Shaft Subassembly**  
**Courtesy of GENERAL MOTORS CORP.**

3. Install drive shaft subassembly into pump housing. Install vanes into pump rotor. With holes positioned correctly onto dowel pins, install pump ring into pump housing.
4. Lubricate NEW "O" ring with power steering fluid, and install into pump body. Install pressure plate and pressure plate spring.
5. Lubricate NEW "O" ring with power steering fluid, and install into end cover. Lubricate outer edge of end cover with power steering fluid. Press end cover into pump housing. When installing retaining ring into groove, ensure opening of ring is near access hole in pump housing. See **Fig. 19** .



**Fig. 19: Installing End Cover & Retaining Ring**  
 Courtesy of GENERAL MOTORS CORP.

## TORQUE SPECIFICATIONS

### TORQUE SPECIFICATIONS

Application	Ft. Lbs. (N.m)
A/C Compressor	
Mounting Bolts	37 (50)
Rear Bracket Mounting Bolts	23 (31)
Connecting Rod-To-Relay Rod Nut	35 (47)
Coolant Reservoir Bolts	97 (11)
Coupling Shield Retainer and Lock Nut	80 (109)
Differential Carrier Shield Mounting Bolts	18 (25)

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Engine Protection Shield-To-Frame Bolts	
"C" & "K" Series	15 (20)
Fan Clutch	
Bolt	24 (33)
Nut	42 (57)
Fan Shroud (Upper)	
"L" & "M" Series	11 (15)
Filler Neck Tube Mounting Bolt	15 (20)
Idle Arm Ball Stud Nut	
"C" & "K" Series	46 (62)
"G", "L", "M" & "S" Series	35 (47)
"T" Series	60 (82)
Idle Arm Mounting Bolts	
"C" & "K" Series	73 (99)
"G" Series	74 (100) + 40 degrees
"L" & "M" Series	77 (105)
"S" & "T" Series	80 (108)
Intermediate Shaft Lower Pinch Bolt	
"C" & "K" Series	35 (47)
"G" Series	45 (61)
"L" & "M" Series	30 (41)
"S" & "T" Series	26 (35)
Pitman Arm-To-Connecting Rod Ball Stud Nut	
"G" Series	35 (47)
"L" & "M" Series	48 (62)
Pitman Arm-To-Pitman Shaft Nut	35 (47)
Pitman Arm-To-Relay Rod Nut	61 (83)
Pitman Arm-To-Steering Gear Nut	184 (250)
Pitman Shaft Preload Adjustment Lock Nut	23 (31)
Power Steering Hoses	
To-Power Brake Booster	20 (27)
To-Steering Gear	
"C" & "K" Series	21 (28)
"G", "L" & "M" Series	20 (27)
"S" & "T" Series - 2.2L Engine	18 (25)
"S" & "T" Series - 4.3L Engine	22 (30)
To-Steering Pump	

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"C" & "K" Series	21 (28)
"G", "L" & "M" Series	20 (27)
"S" & "T" Series	18 (25)
Pump Filler Neck Retaining Nut	18 (25)
Rack Piston End Plug	111 (150)
Recirculating Balls Clamp Screw	43 (58)
Relay Rod Ball Stud Nut	
"C" & "K" Series	46 (62)
"G" Series	35 (47)
"S" Series	
To-Idler Arm	35 (47)
To-Pitman Arm	35 (48)
Shock Absorber	
To-Crossmember Bracket Nut	44 (60)
To-Relay Rod Nut	
"C" & "K" Series	46 (63) - 59 (80) maximum
"T" Series	46 (63)
Shock Absorber Ball Stud Mounting Nut	30 (40)
Side Cover Bolts	44 (60)
Stabilizer Bar Link Nut	13 (17)
Steering Gear Mounting Bolts	
"C", "G" and "K" Series	100 (135)
"L", "S" & "T" Series	55 (75)
"M" Series	105 (142.5)
Steering Linkage Shield Bolts	24 (32)
Steering Pump	
Mounting Bolts	
"C", "G", "K", "L" & "M" Series	37 (50)
"S" & "T" Series - 2.2L Engine	22 (30)
"S" & "T" Series - 4.3L Engine	37 (50)
Mounting Nuts	37 (50)
Steering Pump Mounting Bracket	
Bolts	
"C", "G", "K", "L" & "M" Series	37 (50)
"S" & "T" Series - 2.2L Engine	37 (50)
"S" & "T" Series - 4.3L Engine	30 (41)
Nuts	

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"C", "G", "K", "L" & "M" Series	30 (41)
"S" & "T" Series - 2.2L Engine	37 (50)
"S" & "T" Series - 4.3L Engine	30 (41)
Steering Pump-To-Engine Bolts	37 (50)
Tie Rod Adjuster Clamp	
Bolt	16 (21)
Nut	
"C" Series Old Style - With "I" Beam	77 (104)
"G" Series	18 (25)
Tie Rod Arm Bolts	487 (660)
Tie Rod End Ball Stud Nut	
"C" & "K" Series New Style - Without "I" Beam	33 (45)
"C" & "K" Series Old Style - Without "I" Beam	46 (62)
"C" Series Old Style - With "I" Beam	65 (88)
"G" Series & "L"	35 (47)
"M" Series	36 (49)
"S" & "T" Series	39 (53)
Tie Rod-To-Relay Rod Nut	35 (47)
Tie Rod Jam (Adjuster) Nut	50 (68)
Wheel Lug Nuts	92 (125)
INCH Lbs. (N.m)	
Fan Shroud (Upper)	
"C" & "K" Series	80 (9)
"G" Series	71 (8)
"T" Series	89 (10)